Photoprocesses in Hybrid Nanostructures

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Researchers in the Chemistry Division at Argonne National Laboratory have recently studied the unusual photochemistry of molecular J-aggregates on the surface of noble metal nanoparticles. Noble metal nanoparticles are known for free electron waves, or plasmons, that produce extraordinarily intense and confined electromagnetic waves within a few nanometers of the particles' surfaces. By using molecular J-aggregates, known for their high absorption cross sections, a uniform monolayer of organic electron donors was placed on the surface of the nanoparticles. Ultrafast optical spectroscopy studies revealed a multi-electron, photoinduced reduction of the nanoparticles by the J-aggregates when the plasmon band was optically excited with a femtosecond pulse of light. Reversible charge storage of approximately 300 electrons by the 10 nm diameter nanoparticles was shown. The results will appear in the May 1 issue of the *Journal of the American Chemical Society*. Through a joint collaboration between the Chemistry and Materials Science Divisions, scanning near-field optical microscopy studies on organized patterns of closely spaced metallic nanoparticles reveal collective plasmon character. Ultimately, the unusual photochemical properties of functionalized nanoparticles is expected to enable a modulation of collective plasmons properties for sub-diffraction limited photon propagation in nanostructures.